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(54) **SECURE CONFIGURATION OF MOBILE APPLICATION**

(71) Applicants: **Juergen Schneider**, Ludwigshafen (DE); **Paul El Khoury**, Heidelberg (DE); **Sami Lechner**, Heidelberg (DE)

(72) Inventors: **Juergen Schneider**, Ludwigshafen (DE); **Paul El Khoury**, Heidelberg (DE); **Sami Lechner**, Heidelberg (DE)

(73) Assignee: **SAP SE**, Walldorf (DE)

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H04L 29/06	(2006.01)
H04W 4/00	(2009.01)
H04W 12/06	(2009.01)
G06F 21/43	(2013.01)
G06F 21/57	(2013.01)
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CPC ***H04L 63/08*** (2013.01); ***G06F 21/43*** (2013.01); ***G06F 21/57*** (2013.01); ***H04W 4/003*** (2013.01); ***H04W 12/06*** (2013.01); *G06F 8/61* (2013.01); *G06F 2221/2103* (2013.01); *H04W 12/02* (2013.01)

(58) **Field of Classification Search**

CPC G06F 21/305; G06F 21/335; G06F 21/35; G06F 21/572; G06F 21/6209; G06F 2221/2103; G06F 2221/2119; G06F 8/61; H04L 63/08

USPC 726/6

See application file for complete search history.

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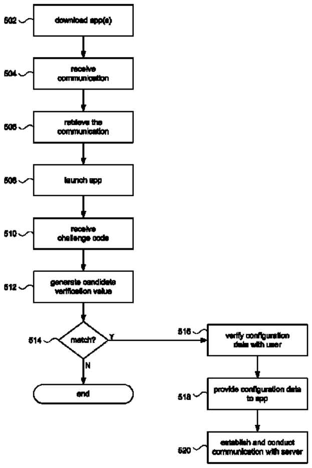
Primary Examiner — Linglan Edwards
Assistant Examiner — Gary Gracia
(74) *Attorney, Agent, or Firm* — Fountainhead Law Group PC

(57) **ABSTRACT**

Secure configuration of a mobile application ("app") includes sending the required configuration data for the app to the user's mobile computing device in a communication, for example an email with an attachment. A verification value is included in the attachment to protect the authenticity and integrity of the configuration data. A challenge code is issued to the user (or group of users). The challenge code is used to verify the configuration data.

18 Claims, 10 Drawing Sheets


502
download app(s)
504
receive communication
506
retrieve the communication
508
launch app
510
receive challenge code
512
generate candidate verification value
514
match?
Y
N
end
516
verify configuration data with user
518
provide configuration data to app
520
establish and conduct communication with server

(51) **Int. Cl.**

G06F 9/445	(2006.01)
H04W 12/02	(2009.01)

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2013/0166899	A1 *	6/2013	Courtney	G06F 21/53 713/100
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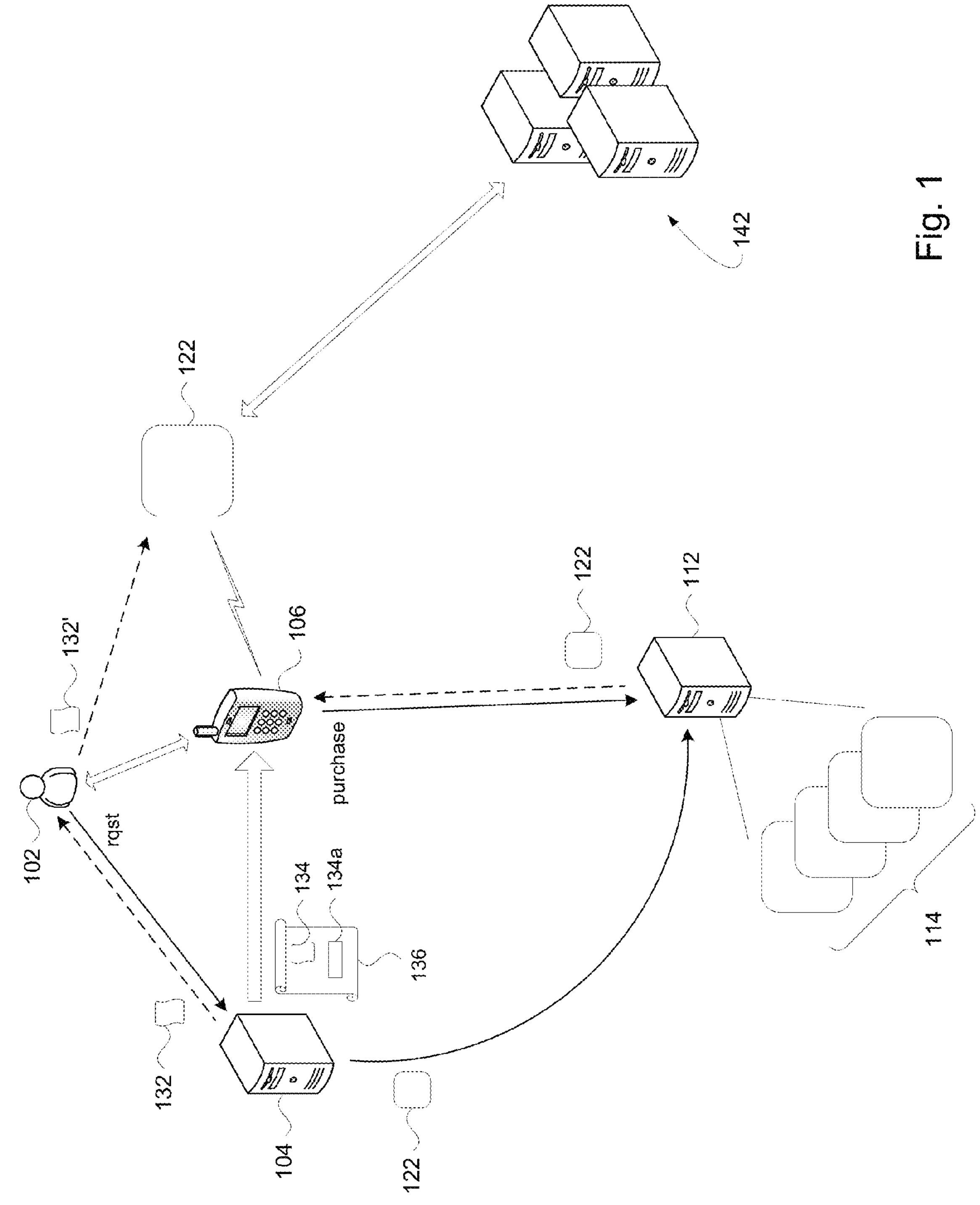

102
rqst
132'
132
104
122
106
purchase
134
134a
136
122
112
122
114
122
142

Fig. 1

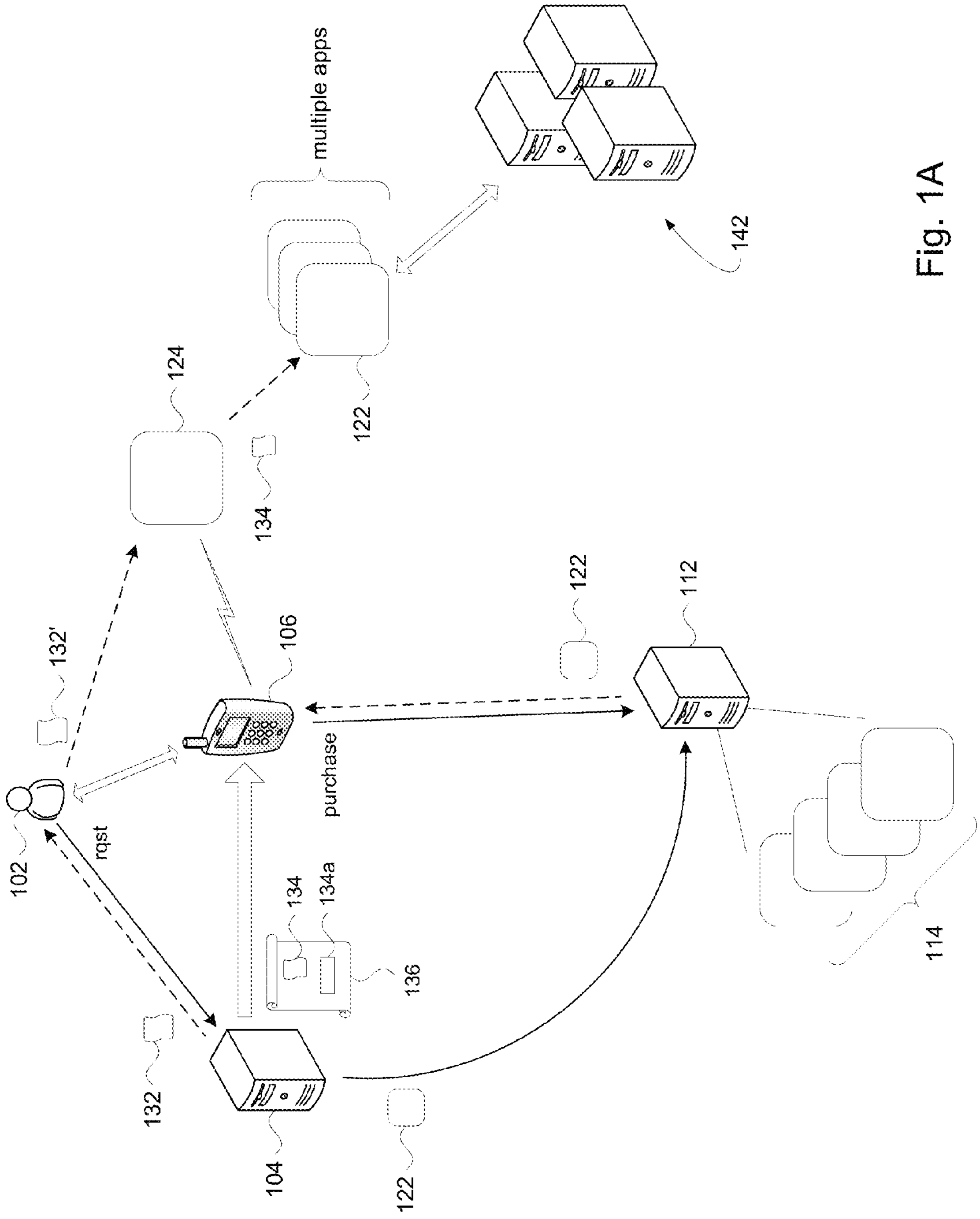
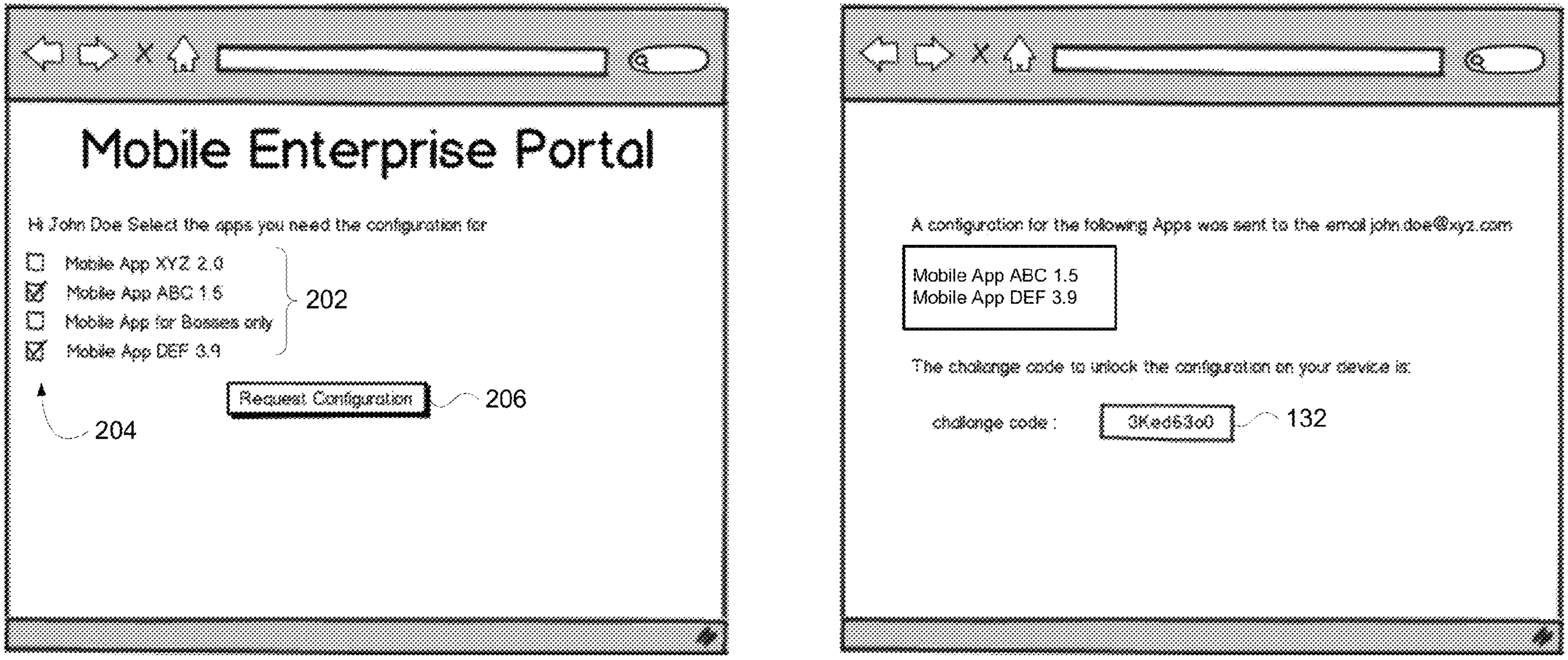

102
rqst
132
132'
104
106
122
124
134
134
134a
136
purchase
122
112
122
114
multiple apps
142

Fig. 1A



Mobile Enterprise Portal

Hi John Doe Select the apps you need the configuration for

- ☐ Mobile App XYZ 2.0
- ☒ Mobile App ABC 1.5
- ☐ Mobile App for Bosses only
- ☒ Mobile App DEF 3.9

Request Configuration

Screen #1

A configuration for the following Apps was sent to the email john.doe@xyz.com

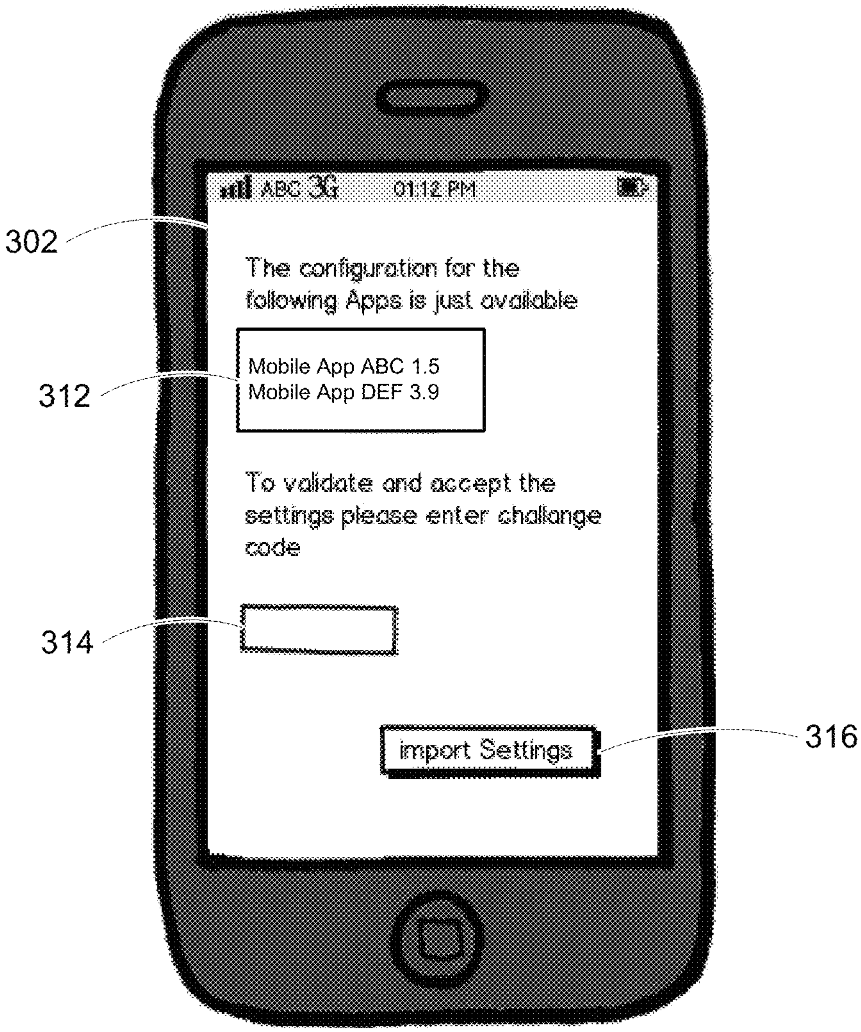
Mobile App ABC 1.5
Mobile App DEF 3.9

The challenge code to unlock the configuration on your device is:

challenge code : 3Ked63o0

Screen #2

Fig. 2



The configuration for the following Apps is just available

Mobile App ABC 1.5
Mobile App DEF 3.9

To validate and accept the settings please enter challange code

Fig. 3

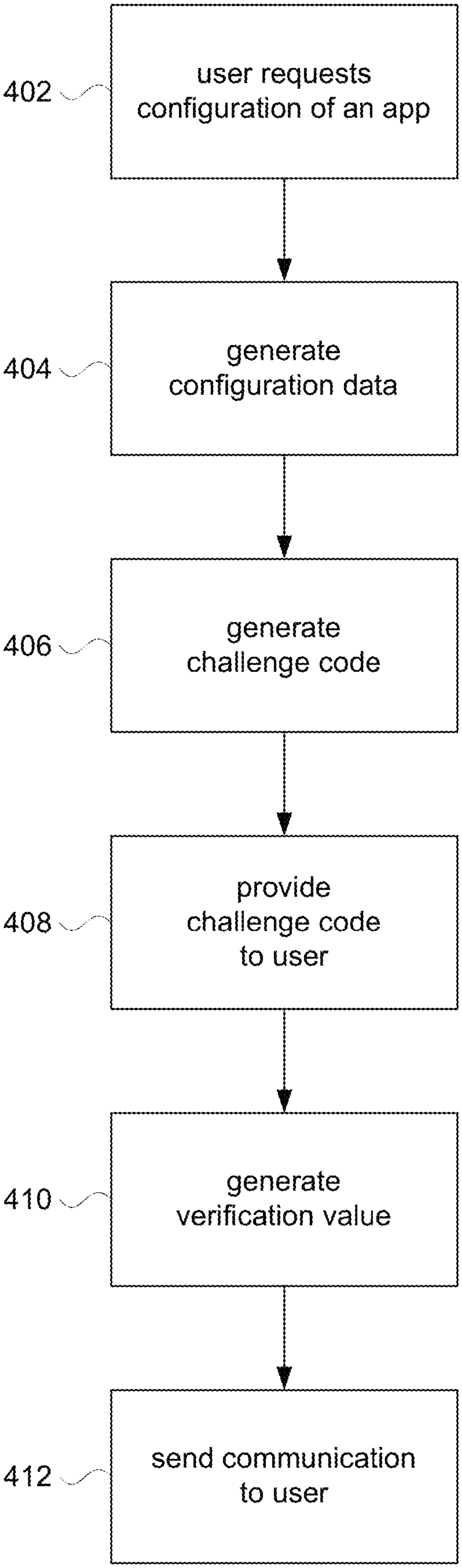

402
user requests configuration of an app
404
generate configuration data
406
generate challenge code
408
provide challenge code to user
410
generate verification value
412
send communication to user

Fig. 4

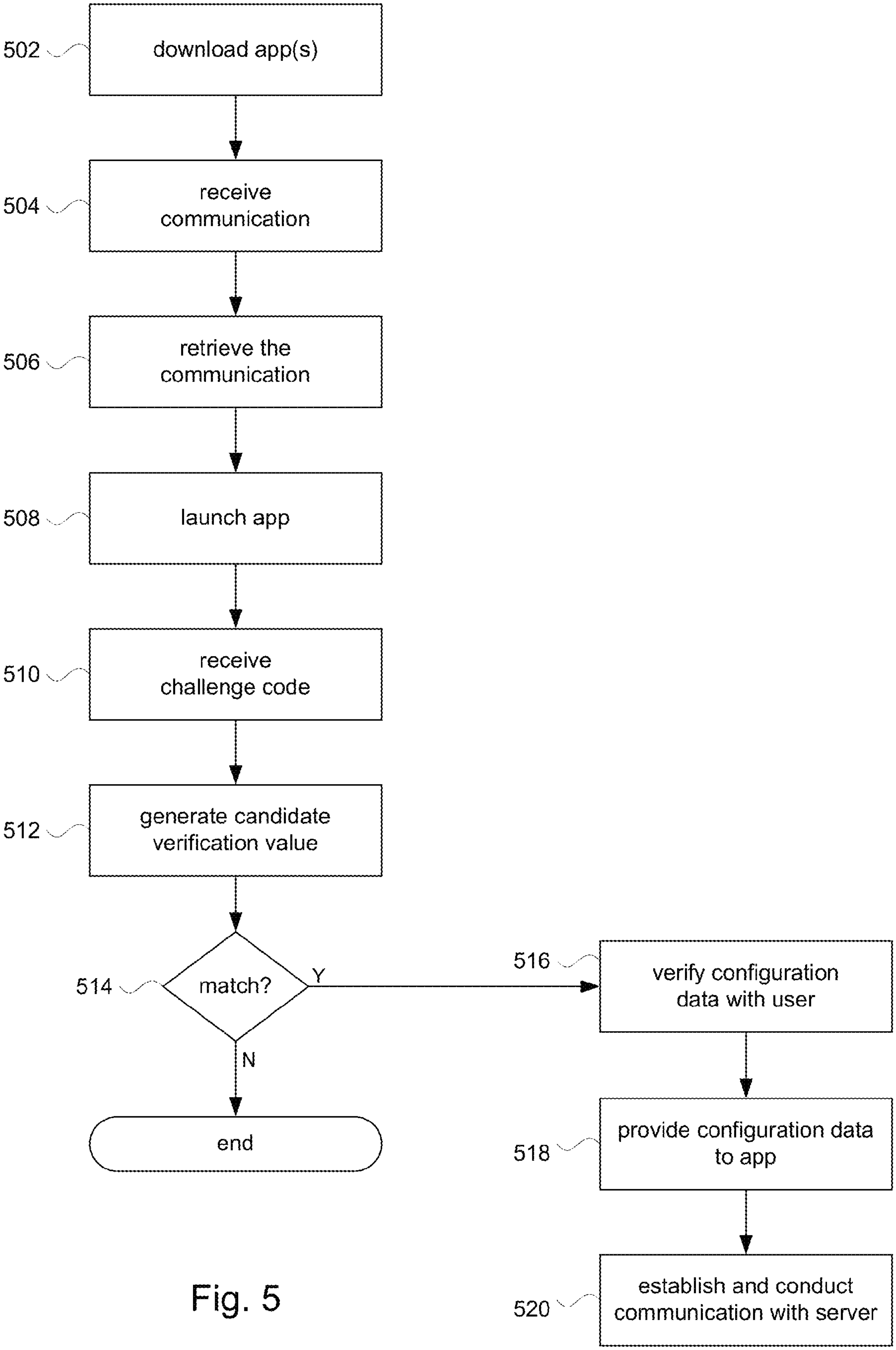

502
download app(s)
504
receive communication
506
retrieve the communication
508
launch app
510
receive challenge code
512
generate candidate verification value
514
match?
Y
N
end
516
verify configuration data with user
518
provide configuration data to app
520
establish and conduct communication with server

Fig. 5

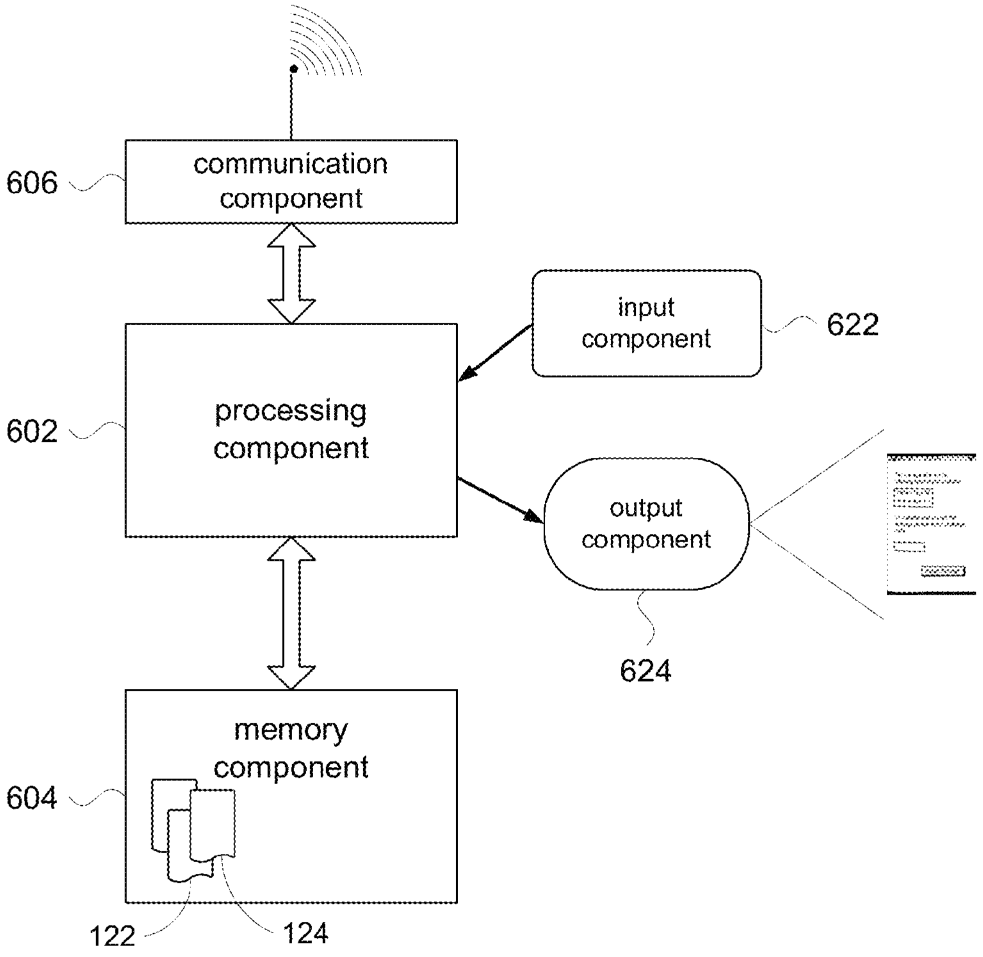

606
communication component
input component
622
602
processing component
output component
624
memory component
604
122
124

Fig. 6

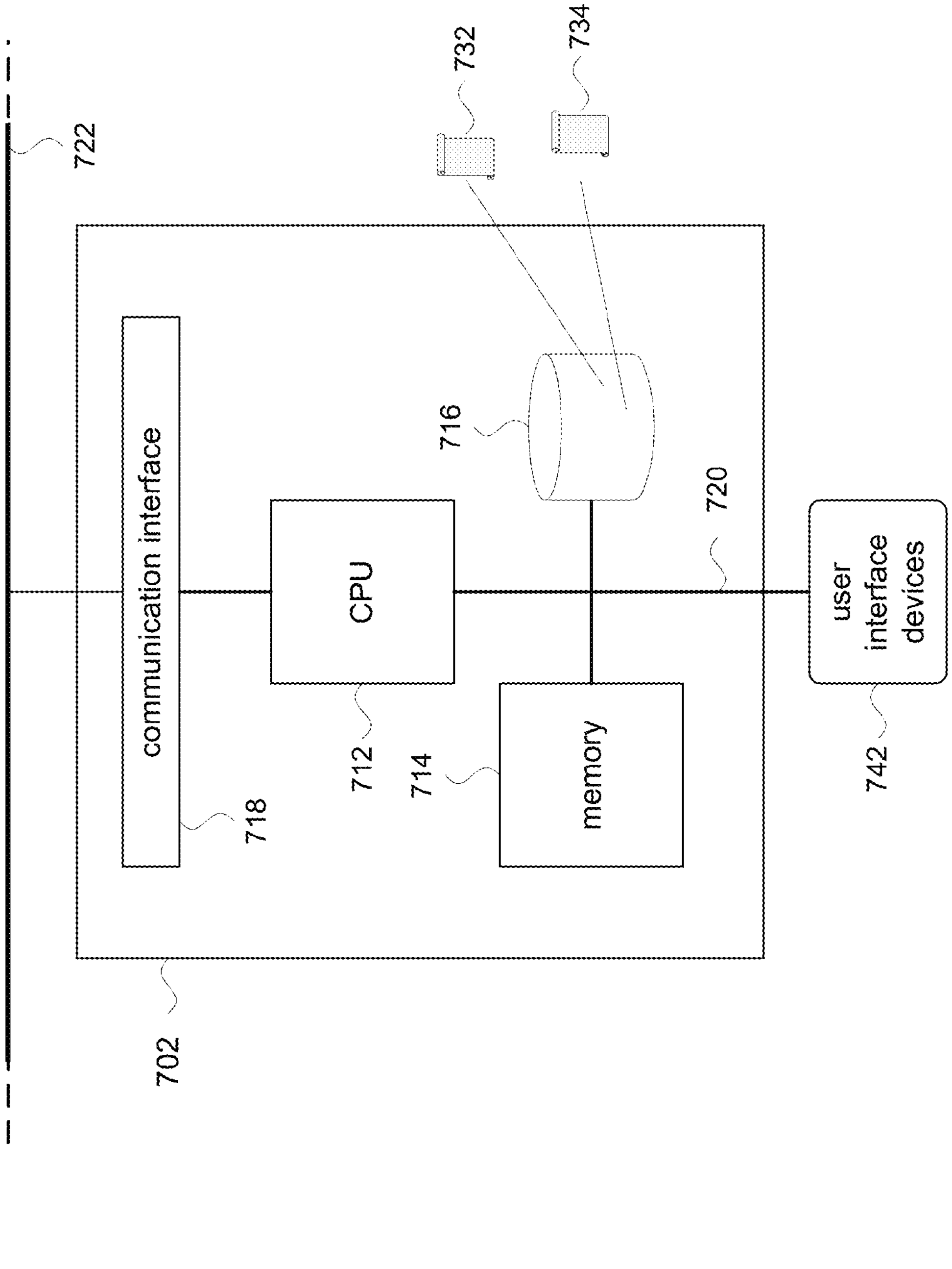

722
732
734
communication interface
CPU
716
720
user interface devices
712
714
memory
718
742
702

Fig. 7

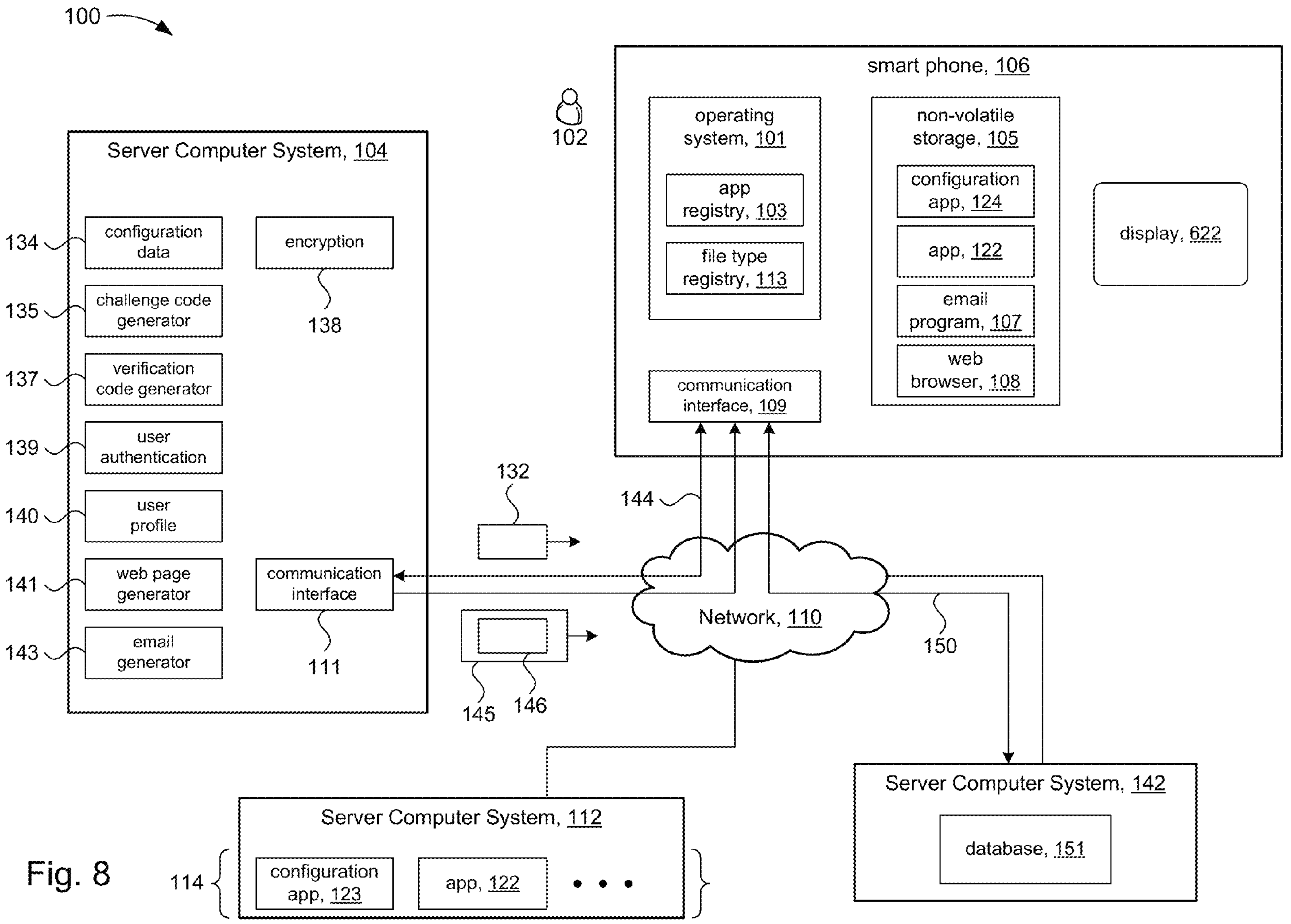

100
Server Computer System, 104
134
configuration data
135
challenge code generator
137
verification code generator
139
user authentication
140
user profile
141
web page generator
143
email generator
encryption
138
communication interface
111
102
smart phone, 106
operating system, 101
app registry, 103
file type registry, 113
communication interface, 109
non-volatile storage, 105
configuration app, 124
app, 122
email program, 107
web browser, 108
display, 622
132
144
145
146
Network, 110
150
Server Computer System, 112
114
configuration app, 123
app, 122
• • •
Server Computer System, 142
database, 151

Fig. 8

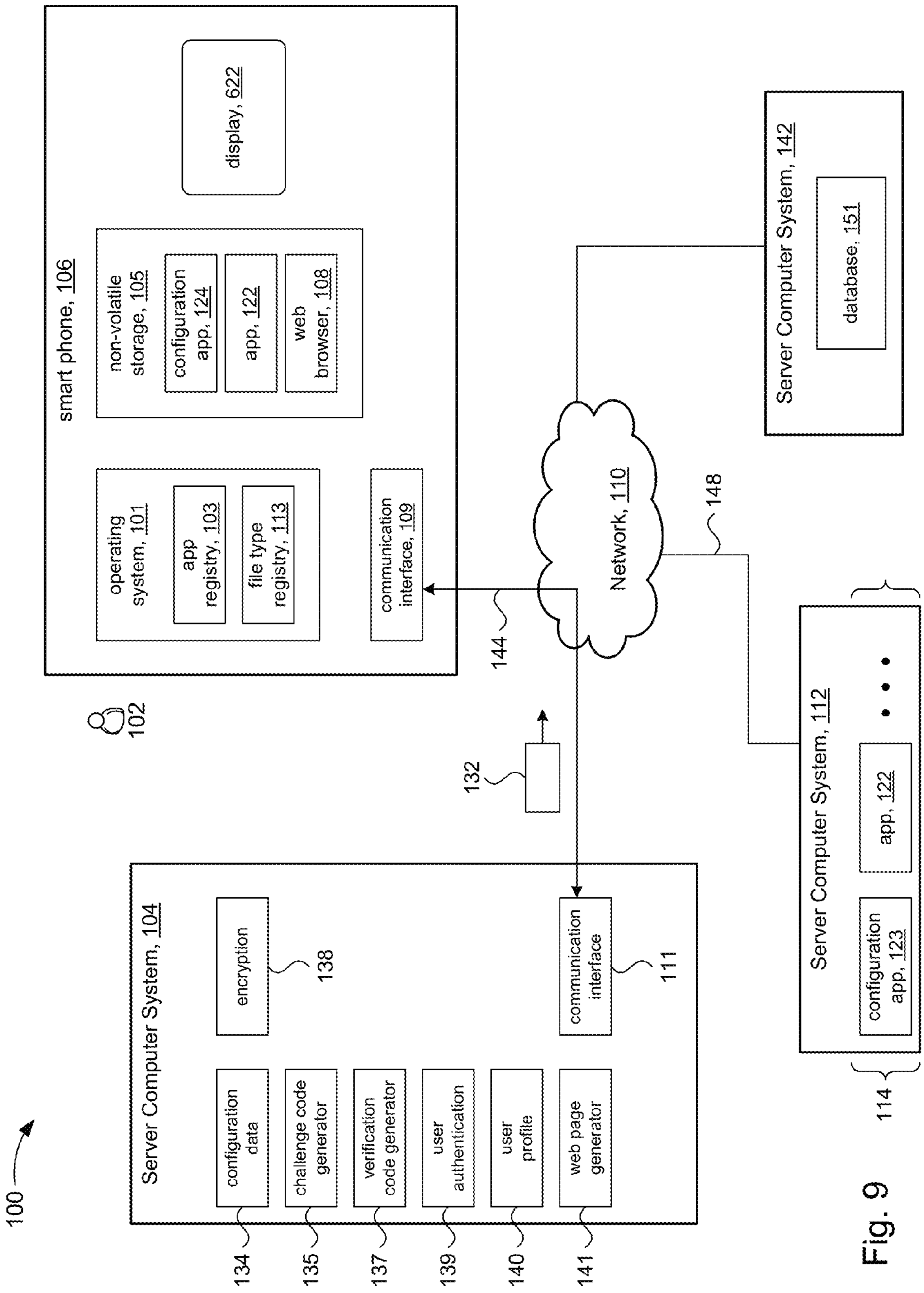

100
smart phone, 106
display, 622
non-volatile storage, 105
configuration app, 124
app, 122
web browser, 108
operating system, 101
app registry, 103
file type registry, 113
communication interface, 109
102
144
132
Network, 110
148
Server Computer System, 142
database, 151
Server Computer System, 104
configuration data
challenge code generator
verification code generator
user authentication
user profile
web page generator
encryption
communication interface
134
135
137
139
140
141
138
111
Server Computer System, 112
configuration app, 123
app, 122
114

Fig. 9

SECURE CONFIGURATION OF MOBILE APPLICATION

BACKGROUND

Unless otherwise indicated herein, the approaches described in this section are not prior art to the claims in this application and are not admitted to be prior art by inclusion in this section.

Mobile applications ("apps") running on mobile computing devices such as smart phones and tablet devices are typically downloaded by users from public application stores ("app store") available on the Internet. The proliferation of mobile computing devices and their level of computing capabilities have made such devices viable alternatives as remote clients to backend systems. For example, an organization may have several business application systems that support the organizations. Mobile computing devices allow user of the organization (e.g., sales people) to access these backend systems remotely.

Client-side applications for mobile devices can be distributed through an appstore channel just like any other mobile app. Business apps, however, typically require an amount of configuration which app generally do not require. For example, after download and installation on the mobile computing device, a business app may need to be configured with information about the organization's servers ("backend servers"), resource address, and port (typically in the form of a Uniform Resource Locator, URL) and any other additional app-specific configuration information, such as user interface settings, security policy information, and so on. For non-technical users, such configuration details can be difficult to enter manually into the app, time-consuming, error-prone, and thus pose an impediment to broad and fast adoption of any mobile apps the organization may want to push out.

In addition, the integrity and authenticity of such configuration information is crucial for the secure operation of an app and to protect against misuse of personal data, identity, and confidential data processed by the app. For example, if the configuration information is somehow attacked or hacked, the user may inadvertently configure an app to connect to a malicious server without the user's knowledge. When the user enters their login information (e.g., username and password), the hacker will be given information allowing them to break into the real servers in the organization.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** illustrates an arrangement of components in accordance with the present disclosure.

FIG. **1**A illustrates an alternative arrangement of components in accordance with the present disclosure.

FIG. **2** shows a portal interface that an application server may present to a user.

FIG. **3** shows a display that a mobile computing device may present to a user.

FIG. **4** illustrates an example of processing that may be performed by the application server.

FIG. **5** illustrates an example of processing that may be performed by the mobile computing device.

FIG. **6** shows a system block diagram of a mobile computing device in accordance with the present disclosure.

FIG. **7** shows a system block diagram of an application server in accordance with the present disclosure.

FIG. **8** shows a block diagram in accordance with an embodiment of the present disclosure.

FIG. **9** shows a block diagram of a further embodiment in accordance with the present disclosure.

DETAILED DESCRIPTION

In the following description, for purposes of explanation, numerous examples and specific details are set forth in order to provide a thorough understanding of the present disclosure. It will be evident, however, to one skilled in the art that the present disclosure as defined by the claims may include some or all of the features in these examples alone or in combination with other features described below, and may further include modifications and equivalents of the features and concepts described herein. Like or identical elements of the embodiments described below are designated by identical reference numerals throughout the description.

FIG. **1** shows a typical arrangement for configuring an app in accordance with embodiments of the present disclosure. User **102** represents a user in the organization. The user **102** may have a mobile computing device **106** (e.g., smart phone, computer tablet, and so on) that they use for conducting business on behalf of the organization; e.g., a sales person, a procurement specialist in manufacturing, etc.

The organization may provide and support an application server **104** to provide apps (e.g., app **122**) that execute on the user's mobile computing device **106**. The application server **104** may upload the app **122** to an app store server **112** (e.g., Apple® Appstore) which hosts a library **114** of apps for downloading to mobile computing devices such as mobile computing device **106**. The organization may provide apps to facilitate planning and scheduling vacations, to review customer records or sales orders, to access customer accounting information, to access production data, and so on. The apps developed for the organization are typically intended to facilitate access to the organization's data stored in the organization's backend servers **142**.

The user **102** may interact with the app store server **112** to purchase the app **122**. In some embodiments, the app **122** may be a free download. For example, in the case of an organization wanting to distribute the app to its employees, the app **122** is likely to be free, and so "purchasing" simply means the user **102** downloading the free app from the app store server **112** to their mobile computing device **106**.

The user **102** may interact with the application server **104** to inform the application server that they want to configure an app **122** that they currently have or are planning to install on their mobile computing device **106**. For example, configuring the app **122** may involve providing configuration data to the app so that the app can communicate with one or more servers **142** of the organization. In some embodiments, the user **102** makes a request to the application server **104**, and in response the application server may provide the user with a challenge code **132**. In addition, the application server **104** may send configuration data **134** and a verification value **134***a* to the user **102** via a communication **136**.

When the user **102** retrieves the communication **136** using their mobile computing device **106**, the mobile computing device may launch the app **122**. As will be explained in more detail below, the user **102** may provide a challenge code **132'** to the app **122**, which may then verify the configuration data **134**. If the configuration data **134** is deemed to be verified, then the app **122** may use the configuration data to conduct communications with the organization's server(s) **142**.

Referring to FIG. **1**A, in some embodiments, a configuration app **124** may be installed on the user's mobile computing device **106**. When the user **102** retrieves the communication **136** with their mobile computing device **106**, the configuration app **124** may be launched to verify the configuration data **134**. If the configuration data **134** is deemed to be verified (e.g., using the user-provided challenge code **132'**), then the configuration app **124** may provide the configuration data **134** to the app **122**, which may then conduct communications with the organization's server(s) **142**. In some embodiments, the configuration data **134** may provide information that allows the configuration app **124** to configure multiple apps.

FIG. **2** shows illustrative examples of a portal interface that the application server **104** may present to the user **102**. The application server **104** may be accessed in any of several ways. For example, the application server **104** may be accessed over a local communication network such as a local area network. As another example, the user **102** may access the application server **104** from the Internet using a web browser; e.g., using HTTPS if security is desired.

In Screen #**1** of FIG. **2**, the portal interface may present to the user **102** a list **202** of apps that the application server **104** supports. For example, the list **202** may include apps that can be downloaded from the app store server **112**. The user **102** may select one or several apps that they want to configure on their mobile computing device **106**. For example, a set of check boxes **204** can allow the user **102** to select the apps of interest. The user **102** may then indicate they have completed the selection process, for example, by clicking the "Request Configuration" button **206**.

In Screen #**2**, the portal interface may confirm the selection made by the user **102**. In accordance with the present disclosure, the portal interface may display a challenge code **132** to the user **102**. The user **102** may then write down the challenge code **132** (e.g., on a piece of paper), the user may store the challenge code on their mobile computing device **106** (e.g., using a notepad program or by copying the challenge code into a cut & paste buffer of the mobile computing device **106**), and so on.

FIG. **3** shows an illustrative example of a display **302** that may be presented to the user **102** on their mobile computing device **106**, when the user retrieves the communication **136** sent by the application server **104**. The display **302** shown in FIG. **3** is an example of a display that the configuration app **124** (FIG. **1**A) may display when it is launched. In some embodiments, the user's selection of apps made in FIG. **2** may produce configuration data **134** suitable for configuring the selected apps. In addition, the display **302** may show to the user **102** a list **312** of the user's selected apps that will be configured by the configuration data **134**. The display **302** may include an input box **314** for receiving the challenge code **132'** from the user **102**. A button **316** allows the user **102** to begin the verification process. In some embodiments, the functionality of the configuration app **124** may be included in the app **122** to be configured such that a separate configuration app is not necessary.

Additional details will now be discussed in the context of processing in accordance with the principles of the present disclosure. Referring to FIG. **4**, in a step **402**, user **102** may initiate configuration processing for an app on their mobile device **106** using the application server **104**. The user **102** may specify one or more apps **122** to be configured; for example, by using an interface such as illustrated in FIG. **2**.

In a step **404**, the application server **104** may generate configuration data **134** for the one or more apps **122** specified in step **402**. The specific information that comprises the configuration data will vary from one app to another. The configuration data **134** may include information that will allow the app **122** to establish a communication link to the servers **142** in the organization, such as server name, IP address, port numbers, and so on. The configuration data **134** may include data security measures such as encryption and decryption keys. The configuration data **134** may configure the app **122** according to who the user **102** is; for example, certain features may be enabled or disabled for a given user. And so on.

In a step **406**, the application server **104** may generate a challenge code **132**. The challenge code **132** may be a randomly generated number, a random text string, a random string of alphanumeric characters, and in general may include any random string of printable characters. The challenge code **132** may be provided to the user **102** (step **408**), for example, by displaying the challenge code on the portal interface shown in FIG. **2**. The user **102** may then write down the challenge code **132** to be used later on, or copy the challenge code into the cut and paste buffer of the mobile computing device **106** for temporary storage.

In a step **410**, the application server **104** may generate a verification value **134***a* (FIG. **1**) using the challenge code **132** that the application server generated in step **406** and the configuration data **134** generated in step **404**. In an embodiment, for example, a hash-based message authentication code (HMAC) may be computed by concatenating the configuration data **134** with the challenge code **132**, and feeding the concatenated string into a secure hash function to produce the verification value **134***a*. Typical secure hash functions include SHA 1 or SHA-256. It will be appreciated of course that the verification value **134***a* may be produced using any of several known secure hash functions performed on the combination of configuration data **134** and the challenge code **132**. Moreover, any deterministic and reproducible combination of the configuration data **134** and the challenge code **132** may be used as input to the secure hash function. The configuration data **134** and the challenge code **132** may be "combined" in any way and order. The configuration data **134** and the challenge code **132** may be concatenated (disclosed above), the configuration data **134** and the challenge code **132** may be encrypted and the resulting ciphers may be combined, and so on. It is noted that the secure hash function used for generating the verification value **134***a* is a "one-way" function. In other words, applying the same secure hash function to the same combination of configuration data **134** and challenge code **132** will always lead to the same verification value **134***a*, but the configuration data **134** and the challenge code **132**, in particular, cannot be recovered from the verification value **134***a*.

In a step **412**, a communication **136** is sent to the user **102**. In accordance with principles of the present disclosure, the communication **136** comprises the configuration data **134** and the verification value **134***a*. In some embodiments, the communication may be an email message having an attachment. In other embodiments, the communication may be an HTTP redirect response, directly launching the app **122** to be configured or a dedicated configuration app **124** on the mobile device. It will be appreciated that other suitable forms of sending the communication **136** to the user **102** may be used. As will be explained in more detail below, the challenge code **132** provided to the user in step **408** may then be used to verify the configuration data **134**, but the challenge code **132** itself is not contained in communication **136**.

As indicated in the foregoing discussion, in some embodiments there is a one-to-one association between the challenge code **132** and a user; the one user requests a configuration, receives the challenge code, and as will be explained below uses that challenge code to verify configuration data for app **122** on their mobile computing device. In some situations however, it may be more efficient to allow a single challenge code **132** to be used for multiple users. For example, suppose an initial roll-out of an app is targeted for deployment to a large group of users in an organization. A single user (e.g., a department manager) may log onto the application server **104**, initiate a request for configuration of the app to be rolled out, and receive a single challenge code **132** (step **408**). The application server **104** may then generate the verification value **134***a*, and the communication **136** comprising the configuration data **134** and the verification value **134***a*. The application server **104** may be provided with a list of users who are to receive the communication **136** (step **412**). The department manager may then distribute the challenge code **132** to the group of users. Each user may then download the app and using the common challenge code **132** verify the configuration data **134** for that app. In this way, only one single challenge code and one verification value need to be generated by the application server **104**, rather that generating as many challenge codes and verification values as there are users in the large group of users.

In accordance with various embodiments of the present disclosure, the communication channel over which the application server **104** provides the challenge code **132** to the user **102** may be separate from the communication channel over which the communication **136** is delivered to the user, or the two communications may take place over the same secure communication channel, but as separate communication steps. The communication channel over which the challenge code **132** is provided to the user **102** may be deemed to be a trusted channel. For example, the user **102** may interact directly with the application server **104** over a secure network connection, which is presumably accessed over the organization's intranet, for example, to display the challenge code **132** on a graphical user interface or web page before the communication **136** is delivered. The user **102** may receive the challenge code **132** from a colleague (e.g., a department manager may distribute the challenge code to a group of users), and so on. The communication **136**, on the other hand, is provided to the user **102** separately, for example, by emailing the communication in an attachment, or by attaching it as parameter to an HTTP redirect response URL and sending the HTTP redirect response as the last step of the configuration request dialog after the challenge code **132** was displayed to the user **102**. By using different communication channels to provide the challenge code **132** separately from how the communication **136** is delivered, an additional level of security is provided since it may be difficult to attack or otherwise hack each communication channel. For example, the challenge code can also be communicated to the user by sending a short message service (SMS) text to the mobile computing device **106**.

Referring to FIG. **5**, configuration processing in the mobile computing device **106** in accordance with principles of the present disclosure is explained. In a step **502**, at some time, the user **102** may download the app(s) **122** for which configuration processing is needed. The app **122** may be purchased before the user **102** logs onto the application server **104** to initiate configuration processing, or after the user has logged onto the application server. In the "large group" scenario, the application server **104** may generate the challenge code **132** and send out a communication **136** (step **412**) before they even know about the app **122**.

In a step **504**, the user **102** may receive the communication **136** sent by the application server **104** (step **412**). For example, if the communication **136** is an email, the user **102** may be notified that an email has arrived in their mailbox. In some embodiments, if the communication **136** is not by email but by means of an HTTP redirect response, the app **122** to be configured or the configuration app **124** may be launched via the redirect URL (also referred to as URL forwarding) pointing to the custom URL scheme of the app to be launched.

In a step **506**, the user **102** may retrieve the communication **136** using their mobile computing device. For example, the user **102** may open an email and open an attachment which contains the communication **136**. In a step **508**, an app that is associated with the attachment may be launched when the user **102** opens the attachment. For example, when an attachment has a file type "PDF", a PDF reader application that is associated with file type PDF can be launched in order to read the attachment. Likewise, the communication **136** has a file type. In some embodiments, the communication **136** may be associated with the app **122** ("target app") that is to be configured, in which case the target app is launched when the user **102** opens the attachment. In another embodiment, the communication **136** may be associated with a configuration app **124** (FIG. 1A), in which case the configuration app is launched. In some embodiments, where the communication **136** is not by email but by means of an HTTP redirect response, the app **122** to be configured or the configuration app **124** directly may retrieve the communication **136** as part of the HTTP redirect URL used for launching.

In a step **510**, the app (whether the target app **122** or the configuration app **124**) reads in the data comprising the communication **136**. The app may display an input box (e.g., **314**, FIG. **3**) on the mobile computing device **106** allowing the user **102** to enter the challenge code **132** provided to the user in step **408** (user-provided challenge code **132'**).

In a step **512**, the app (whether the target app or the configuration app) generates a candidate verification value using the configuration data **134** received in the communication **136** and the challenge code **132'** received in step **510**. In a step **514**, if the candidate verification value matches the verification value **134***a* provided in the communication **136**, then the configuration data **134** is deemed to be verified, and processing may proceed to a step **516**.

In step **516**, the app (whether the target app or the configuration app) may display the configuration data **134** received in the communication **136** to the user **102** on the mobile computing device **106**. The user **102** may be prompted to accept or deny the configuration data. This step may be performed as an added measure of security, giving the user **102** the final word whether or not to proceed with using the configuration data **134** to configure the target app **122**.

In a step **518**, the now verified communication data **134** may be provided to the target app **122**. In an embodiment where the steps **510**-**516** are performed by the target app **122**, then the target app simply configures itself with the configuration data **134**.

In an embodiment where the steps **510**-**516** are performed by the configuration app **124**, then the configuration app may provide the configuration data **134** to the target app **122**. The specific details on how the configuration data **134** is provided to the target app **122** depends on the services provided by the operating system (OS) of the mobile computing device **106**, and the conventions adopted for providing configuration data to an app. For example, each app may designate a directory or a file in the file system for storing its configuration data. The configuration app **124** may store the configuration data **134** in those files. The OS may provide interprocess communication services, allowing the configuration app **124** to send the configuration data **134** to the target app **122** using the OS's interprocess communication services, such as custom URL schemes, intents, sockets, memory pipes or the like.

In a step **520**, the target app **122** is now properly configured for communication with the backend servers **142** of the organization. The configuration data **134** may include configuring the target app **122** for secured transmission and reception of data, enabling or disabling certain functionality depending who the user is, and so on.

A particular embodiment of a mobile computing device **106** in accordance with the present disclosure is illustrated by the block diagram in FIG. **6**. The mobile computing device **106** may comprise a processing component **602** such as a microcontroller. A memory component **604** may comprise static memory (e.g., flash random access memory, RAM) and/or dynamic memory (dynamic random access memory, DRAM). The memory component **604** may store data and apps that can be executed by the mobile computing device **106**. For example, the memory component **604** may store app **122**, and in some embodiments may store configuration app **124**. The apps may cause the processing component **602** to performs steps such as set forth in FIG. **5**. A communication component **606** may provide a suitable wireless communication channel to the organization's backend servers **142**. The communication component **606** may support several wireless communication formats, including for example, Bluetooth, 3G, and so on.

The mobile computing device **106** may include an input component **622** and an output component **624**. In some embodiments, the input component **622** and the output component **624** may be integrated in one component such as a touch-sensitive display. In other embodiments, they may be separate. In accordance with the present disclosure, the processing component **602** may present certain displays on the output component **624**. For example, when the processing component **602** executes app **122** or configuration app **124**, the output component **624** may present the display illustrated in FIG. **3**.

A particular embodiment of the application server **104** in accordance with the present disclosure is illustrated by the block diagram of FIG. **7**, showing a high level block diagram of a computer system **702** configured to operate in accordance with the present disclosure. The computer system **702** may include a central processing unit (CPU) or other similar data processing component. The computer system **702** may include various memory components. For example, the memory components may include a volatile memory **714** (e.g., random access memory, RAM) and a data storage device **716**. A communication interface **718** may be provided to allow the computer system **702** to communicate over a communication network **722**, such as a local area network (LAN), the Internet, and so on. An internal bus **720** may interconnect the components comprising the computer system **702**.

The data storage device **716** may comprise a non-transitory computer readable medium having stored thereon computer executable program code **732**. The computer executable program code **732** may be executed by the CPU **712** to cause the CPU to perform steps of the present disclosure, for example the steps set forth in FIG. **4**. The data storage device **716** may store data structures **734** such as object instance data, runtime objects, and any other data described herein. In some embodiments, the data storage device **716** may store the configuration data **134** and the verification value **134***a* that is to be sent to the mobile computing device.

A user (e.g., user **102**) may interact with the computer system **702** using suitable user interface devices **742**. They may include, for example, input devices such as a keyboard, a keypad, a mouse or other pointing device, and output devices such as a display.

All systems and processes discussed herein may be embodied in program code stored on one or more non-transitory computer-readable media. Such media may include, for example, a floppy disk, a CD-ROM, a DVD-ROM, a Flash drive, magnetic tape, and solid state Random Access Memory (RAM) or Read Only Memory (ROM) storage units. It will be appreciated that embodiments are not limited to any specific combination of hardware and software. Elements described herein as communicating with one another are directly or indirectly capable of communicating over any number of different systems for transferring data, including but not limited to shared memory communication, a local area network, a wide area network, a telephone network, a cellular network, a fiber-optic network, a satellite network, an infrared network, a radio frequency network, and any other type of network that may be used to transmit information between devices. Moreover, communication between systems may proceed over any one or more transmission protocols that are or become known, such as Asynchronous Transfer Mode (ATM), Internet Protocol (IP), Hypertext Transfer Protocol (HTTP) and Wireless Application Protocol (WAP).

The configuration in FIG. **8** shows additional details of data processing system **100** introduced in FIG. **1**, including details of a mobile computing device **106**, such as a smartphone. The mobile computing device **106** may include a user interface, such as a touch sensitive display **622** that serves both for input and output. The mobile computing device **106** may include an operating system **101** that implements a registry for the application programs that are installed on the mobile computing device **106**. For example, each installed application may be registered in the registry by means of a custom URL scheme that identifies a given app on the mobile computing device **106**. In addition, the operating system **101** may implement a file type registry **113** where the file types that can be processed by a given app are registered. For example, clicking on a file that is stored on the mobile computing device **106** and that has a file type which is registered for a given app may automatically start that app. Depending on the implementation, one or more file types may be registered for the configuration app **124**, or—especially in the absence of a configuration app—for the target app **122** to be configured.

The mobile computing device **106** may include a non-volatile storage **105** for storing apps, for example, app **122**. Suppose the app **122** is the target app to be configured. An additional configuration app **124** may also be stored in the non-volatile storage **105**. The configuration app **124** may implement a configuration program module for configuring the app **122**. Alternatively, a configuration program module may constitute an integral part of the app **122** such that a separate configuration app **124** is not required. The non-volatile storage **105** may further include an email program **107** for receiving email messages with attachments and a web browser **108**.

The mobile computing device **106** may include a communication interface **109** for coupling the mobile computing device **106** to a network **110**, such as the Internet and/or a company's intranet. The communication interface **109** may be an interface to a digital cellular mobile telecommunications network that enables the establishment of connections using the TCP/IP protocol, such as the establishment of an internet session using HTTP or HTTPS and the transmission of email messages. On another communication layer, e.g., the so-called signaling layer in the case of GSM, the communication interface **109** may enable the reception of SMS messages.

The server computer system **104** may include a respective communication interface **111** for coupling to the communication interface **109** via the network **110**. The server computer system **104** may store the configuration data **134** and use a challenge code generator **135** to generate the challenge code

132. In some embodiments, the challenge code generator **135** may be implemented as a pseudo random or true random number generator. The server computer system **104** may include a verification value generator **137** that can be implemented by a program module that is executable to generate the verification value **134***a* (cf. FIG. **1** and FIG. **1**A).

The server computer system **104** may include an encryption module **138** for encryption of the configuration data **134**. The encryption may be performed using the challenge code **132** using any suitable algorithm including symmetric encryption, by asymmetric encryption, etc.

The server computer system **104** may include a user authentication component **139** for authentication of users, such as user **102**. For example, user authentication may be performed by means of a user ID/password combination, biometric authentication and/or other authentication means.

The server computer system **104** may include a database component **140** for storing a user profile for each registered user, such as for user **102**. The user profile of a given user may contain a communication address for electronic communication with that user, such as an email address for sending an email to the mobile computing device **106** and/or a telephone number for sending an SMS message to the mobile computing device **106**, and so on.

The server computer system **104** may include a web page generator **141**, for generating web pages, such as screens #1 and #2 as shown in FIG. **2**, and an email generator **143**. The email generator **143** may be a program module that generates an email to be sent to the email address of the user that requests the configuration in an email attachment that contains the configuration data **134** and the verification value **134***a*. Instead of an email generator **143**, an SMS generator may be utilized to send the configuration data **134** and the verification value **134***a* to the user **102**. In the latter case, this may be done by sending a binary SMS that contains the configuration data **134** and the verification value **134***a*. Alternatively, the challenge code **132** can be sent by SMS, not the configuration data **134** and the verification value **134***a*.

In operation, the user **102** may start the web browser **108** and enter the URL of the app store server **112** that is implemented by a server computer system. The user may select the app **122** and the corresponding configuration app **124** for downloading and installation on the mobile computing device **106**. Installation can be performed by registering the app **122** and the configuration app **124** in the app registry **103** using the custom URL scheme of the app **122** and the custom URL scheme of the configuration app **124**. For the configuration app **124**, a predefined file type may be registered in the file type registry **113**.

Next, the user **102** may enter the URL of the application server **104** into web browser **108** such that a secure network connection **144** is established via the network **110** such as by means of the https protocol. Alternatively, the secure network connection **144** can be established via an intranet rather than via the network **110** or via a virtual private network to provide security for the secure network connection **144**.

The user **102** may need to authenticate against the application server **104** that is implemented by a server computer system, such as by entering his or her username and password combination into the user authentication component **139** via the connection **144**. After successful user authentication, the webpage generator **141** may generate a webpage for the user's entry of his or her request for configuring the app **122** analogous to screen #**1** as shown in FIG. **2**. By clicking the 'request configuration' button **206**, the user **102** may request configuration of the app **122**. In response the challenge code generator **135** may generate the challenge code **132**. The challenge code **132** may then be transmitted from the application server **104** via the connection **144** to the mobile computing device **106** and displayed by means of the web browser **108** on the display **622**.

In addition, the email generator **143** may read the configuration data **134** and trigger the verification value generator **137** to generate a verification value **134***a* such as by concatenating the configuration data **134** and the challenge code **132**, and calculating a message authentication code on the concatenation such as by calculating a hash value for the concatenation using a predefined hashing algorithm. The email generator **143** may generate an email to the email address of the user **102** that is stored in that user's user profile in database component **140** and an email attachment **146** that contains a file comprising the configuration data **134** and the verification value **134***a*.

In some embodiments, the configuration data **134** may be encrypted by the encryption module **138**, such as by symmetric encryption using the challenge code **132** as a symmetric key or as a starter or seed value for calculating a symmetric key. In this instance, the email attachment contains only the encrypted configuration data **134** for providing additional security; for example, the symmetric key which is securely derived from the challenge code **132**, e.g. according to the PKCS#5 standard. Depending on the implementation, the configuration data **134** can be encrypted using the symmetric key and sent to the user without a verification value, as the verification of the configuration data **134** is performed by decrypting the received configuration data **134** using the challenge code. In other embodiments, both the configuration data **134** and the verification value **134***a* are encrypted by means of the symmetric key to provide an additional layer of security.

The resultant email **145** with the email attachment **146** can then be sent from the application server **104** to the email program **107** of the mobile computing device **106**.

The attachment **146** of the email **145** has the predefined file type that is registered in the file type registry **113** for the app **122** to be configured or for configuration app **124**. When the user **102** clicks on the attachment **146**, that action can invoke the app **122** to be configured or configuration app **124**. The app **122** to be configured or configuration app **124** may prompt the user **102** to enter the challenge code **132** that had previously been displayed on the touch sensitive display **622** (user-provided challenge code **132'**).

In some embodiments, the configuration app **124** may use the user-provided challenge code **132'** to generate a candidate verification value (cf. steps **510**, **512** in FIG. **5**), for example, using the same algorithm as the application server **104** by concatenating the configuration data contained in the attachment **146** with the user-provided challenge code **132'** and calculating the message authentication code. If the message authentication code calculated by the mobile computing device **106** matches the verification value **134***a* contained in the communication (e.g., attachment **146** in email **145**), then verification is deemed successful.

If the configuration data **134** has been encrypted by means of the encryption module **138** using the challenge code **132**, the configuration app **124** can use the user-provided challenge code **132'** entered by the user for symmetric decryption of the configuration data **134** before the decrypted configuration data **134** is concatenated with the challenge code **132'**. This can provide an additional level of security as interception of the email **145** is worthless for an attacker since the email **145** does not contain the challenge code **132** that would be required for decrypting of the configuration data **134**.

Upon successful verification, the configuration app **124** may invoke the app **122** by means of the custom URL scheme of the app **122** and provides the configuration data **134** to the app **122** such that configuration is complete.

When the user clicks on app **122** after configuration is complete, the app **122** may use the URL contained in the configuration data **134** to establish an Internet session **150** with one of the backend servers **142**, such as for establishing a database session with database **151**. This may require prior authorization of the user **102** against the backend server **142**. As an alternative, an app group mechanism may be utilized for grouping the configuration app **124** and the app **122** in order to communicate the configuration data **134** such as by putting the configuration data **134** into a known file location to which only the group of apps has access.

As a further alternative, the configuration program module that is implemented by the configuration app **124** me be incorporated within the app **122** itself such that an additional configuration app is not required. In this instance the app **122** itself is invoked when the user clicks on the email attachment **146**.

FIG. **9** shows an alternative to the configuration in FIG. **8**. In contrast to the embodiment of FIG. **8**, the configuration data **134** and the verification value **134***a* are not communicated by means of an email, but instead by a re-direct response. The user authentication and the transmission of the challenge code **132** via the secure network connection **144** may be performed as in the embodiment of FIG. **8**. Next, the user **102** may request the configuration data **134** from the application server **104** via the secure network connection **144**. In response, the webpage generator **141** may generate a re-direct for the web browser **108** that contains the custom URL scheme of the configuration app **124**, the configuration data **134**, and the verification value **134***a*.

In response to the re-direct received from the application server **104**, the web browser **108** may invoke the configuration app **124** using the custom URL scheme of that configuration app **124** and communicate the configuration data **134** and the verification value **134***a* to the configuration app **124** to start the verification and configuration process on the mobile computing device **106**. Alternatively, if the app **122** comprises the configuration program module, the custom URL scheme contained in the re-direct is the custom URL scheme of the app **122**.

It is to be noted that the challenge code **132** may be transmitted via a communication channel that is constituted by the network connection **144**, the touch sensitive display **622** and the user **102**, as the challenge code is displayed on the touch sensitive display and then entered by the user **102** at a later point of time or retrieved from the cut and paste buffer by the user. In contrast, transmission of the configuration data and the verification value, if any, involves only the network connection. As a consequence, the transmission of the challenge code **132** and the transmission of the configuration data/verification value is performed via two different communication channels in this embodiment.

As a further alternative the re-direct response may contain a MIME-type attachment that is analogous to the email attachment **146**.

ADVANTAGES AND TECHNICAL EFFECT

The present disclosure facilitates provisioning and consumption of required initial configuration data for mobile apps in a way which is simple and easy to use, an important consideration for non-technical users. At the same time, it provides means to verify the authenticity and integrity of this initial configuration data by means of a secret (namely, the challenge code) known only to an authorized user (or authorized group of users), thereby considerably reducing the risk of misuse. An easy-to-use and secure onboarding and initial configuration of mobile apps significantly increases adoption and usage of mobile apps generating business value.

The above description illustrates various embodiments of the present disclosure along with examples of how aspects of the present disclosure may be implemented. The above examples and embodiments should not be deemed to be the only embodiments, and are presented to illustrate the flexibility and advantages of the present disclosure as defined by the following claims. Based on the above disclosure and the following claims, other arrangements, embodiments, implementations and equivalents will be evident to those skilled in the art and may be employed without departing from the spirit and scope of the disclosure as defined by the claims.

What is claimed is:

1. A computer-implemented method of configuring an application program of a mobile computing device, the method comprising:

establishing a secure network connection between the mobile computing device and a server computer system;

authenticating a user of the mobile computing device against the server computer system via the secure network connection;

receiving, at the server computer system, a configuration request via the secure network connection from the mobile computing device, the configuration request indicative of a user's request for configuring the application program; and

in response to receiving the configuration request:

generating a challenge code;

sending the challenge code via the secure network connection to the mobile computing device;

encrypting configuration data using a symmetric key, wherein the symmetric key is the challenge code or the symmetric key is derived from the challenge code;

sending the configuration data in encrypted form via the secured network connection to the mobile computing device; and

sending a verification value from the server computer system to the mobile computing device either via an additional communication channel that is different from the secure network connection or as a separate communication over the same secure network connection, wherein the verification value is a hash-based message authentication code (HMAC) produced by applying a secure hash function to a combination of the configuration data with the challenge code,

whereby the mobile computing device, in response to receiving the configuration data and the verification value, invokes a configuration program module to:

prompt the user to enter a challenge code via a user interface;

decrypt the configuration data in encrypted form upon entry of the challenge code via an input component of the mobile computing device;

verify the configuration data using the challenge code entered by the user and the verification value received via the additional communication channel; and

configure the application program using the configuration data in response to verification of the configuration data.

2. The computer-implemented method of claim **1**, wherein the configuration data comprises at least a uniform resource locater (URL) of an additional server computer system, the method further comprising, subsequent to configuration of the application program, steps of:

establishing an additional secure network connection between the configured application program on the mobile computing device and the additional server computer system using the URL contained in the configuration data;

authenticating the user of the mobile computing device against the additional server computer system; and

processing requests exchanged over the authenticated secure network connection between the configured application program on the mobile computing device and the additional server computer system.

3. The computer-implemented method of claim **2**, wherein the configuration data further comprises a port number of the additional server computer system, wherein establishing an additional secure network connection uses the port number.

4. The computer-implemented method of claim **1**, wherein the server computer system comprises a user registration database for storing user registration information, the user registration information comprising reference data for authenticating the user against the server computer system and an address for establishing an additional communication channel for sending the configuration data and the verification value to the mobile computing device, wherein in response to the configuration request and subsequent to a successful authentication of the user against the server computer system, the server computer system retrieves the address from the user registration database and sends the configuration data and verification value to the address via the additional communication channel.

5. The computer-implemented method of claim **4**, wherein either the address is an email address and the configuration data and the verification value are sent from the server computer system to the mobile computing device as an email message or the address is a telephone number of the mobile computing device and the configuration data and the verification value are sent from the server computer system to the mobile computing device as one or more SMS messages.

6. The computer-implemented method of claim **1**, wherein sending the challenge code via the secure network connection to the mobile computing device comprises sending one or more SMS messages.

7. The computer-implemented method of claim **1** further comprising, in response to the configuration request and subsequent to a successful authentication of the user against the server computer system over a secure network connection:

retrieving the configuration data and the verification value; and

sending a response to the configuration request via the same secure network connection to a browser program of the mobile computing device, the response comprising the configuration data, the verification value, and a redirect to a custom URL scheme that references the configuration program module,

whereby the browser program executes the redirect to invoke the configuration program module.

8. The computer-implemented method of claim **1**, wherein the mobile computing device:

receives a first communication that includes the configuration data for the application program and the verification value, the verification value generated from a combination of the configuration data and the challenge code;

receives the challenge code from the user of the mobile computing device;

verifies authenticity of the configuration data using the challenge code from the user including generating a candidate verification value from a combination of the configuration data and the challenge code from the user, wherein the configuration data is deemed verified when the verification value received in the first communication matches the candidate verification value generated; and

provides the configuration data to the application program in response to the configuration data being deemed verified.

9. The computer-implemented method of claim **8**, wherein the application program is a first application program, wherein a second application program in the mobile computing device, different from the first application program, performs the steps of receiving a challenge code and verifying authenticity of the configuration data,

wherein providing the configuration data to the first application program includes the second application program communicating with the first application program,

wherein providing the configuration data to the first application program includes the second application program storing the configuration data in a data file that can be accessed by the first application program,

wherein the first application program uses the configuration data to establish and conduct communications with a server in response to the configuration data being deemed verified by the second application program.

10. The computer-implemented method of claim **1**, wherein the server computer system sends the configuration data and the verification value as an attachment in an email message.

11. The computer-implemented method of claim **1**, wherein the configuration data is used by a mobile application executing on the mobile computing device to establish and conduct communications with a server.

12. A server computer system comprising:

a computer processor;

a memory; and

a data store having stored therein computer executable program code, which when executed by the computer processor, causes the computer processor to:

establish a secure network connection between a mobile computing device and the server computer system;

authenticate a user of the mobile computing device against the server computer system via the secure network connection;

receive, at the server computer system, a configuration request via the secure network connection from the mobile computing device, the configuration request indicative of a user's request for configuring the application program; and

in response to receiving the configuration request:

generate a challenge code by the server computer system;

send the challenge code via the secure network connection to the mobile computing device;

encrypt configuration data using a symmetric key, wherein the symmetric key is the challenge code or the symmetric key is derived from the challenge code;

send the configuration data in encrypted form via the secured network connection to the mobile computing device; and

send a verification value to the mobile computing device via an additional communication channel that is different from the secure network connection, or as a separate communication over the same secure network connection, wherein the verification value is a hash-based message authentication code (HMAC) produced by applying a secure hash function to a combination of the configuration data with the challenge code,

whereby the mobile computing device, in response to receiving the configuration data and the verification value, invokes a configuration program module to:

prompt the user to enter a challenge code via a user interface;

decrypt the configuration data in encrypted form upon entry of the challenge code via an input component of the mobile computing device;

verify the configuration data using the challenge code entered by the user and the verification value received via the additional communication channel; and

configure the application program using the configuration data in response to verification of the configuration data.

13. The server computer system of claim **12**, wherein the configuration data comprises at least a uniform resource locater (URL) of an additional server computer system, wherein the computer executable program code, which when executed by the computer processor, further causes the computer processor to perform actions subsequent to configuration of the application program, the actions including:

establishing an additional secure network connection between the mobile computing device and the additional server computer system using the URL contained in the configuration data;

authenticating the user of the mobile computing device against the additional server computer system; and

processing requests exchanged over the authenticated secure network connection between the configured application program on the mobile computing device and the additional server computer system.

14. The server computer system of claim **12** further comprising a user registration database for storing user registration information, the user registration information comprising reference data for authenticating the user against the server computer system and an address for establishing an additional communication channel for sending the configuration data and the verification value to the mobile computing device, wherein in response to the configuration request and subsequent to a successful authentication of the user against the server computer system, the server computer system retrieves the address from the user registration database and sends the configuration data and verification value to the address via the additional communication channel.

15. The server computer system of claim **12**, wherein the computer executable program code, which when executed by the computer processor, further causes the computer processor to perform actions in response to the configuration request and subsequent to a successful authentication of the user over a secure network connection, the actions including:

retrieving the configuration data and the verification value; and

sending a response to the configuration request via the same secure network connection to a browser program of the mobile computing device, the response comprising the configuration data, the verification value, and a redirect to a custom URL scheme that references the configuration program module,

whereby the browser program executes the redirect to invoke the configuration program module.

16. A non-transitory computer readable storage medium having stored thereon computer executable code, which when executed by a computer causes the computer to:

establish a secure network connection between a mobile computing device and a server computer system;

authenticate a user of the mobile computing device against the server computer system via the secure network connection;

receive, at the server computer system, a configuration request via the secure network connection from the mobile computing device, the configuration request indicative of a user's request for configuring the application program; and

in response to receiving the configuration request:

generate a challenge code by the server computer system;

send the challenge code via the secure network connection to the mobile computing device;

encrypting configuration data using a symmetric key, wherein the symmetric key is the challenge code or the symmetric key is derived from the challenge code;

sending the configuration data in encrypted form via the secured network connection to the mobile computing device; and

send a verification value to the mobile computing device via an additional communication channel that is different from the secure network connection, or as a separate communication over the same secure network connection, wherein the verification value is a hash-based message authentication code (HMAC) produced by applying a secure hash function to a combination of the configuration data with the challenge code,

whereby the mobile computing device, in response to receiving the configuration data and the verification value, invokes a configuration program module to:

prompt the user to enter a challenge code via a user interface;

decrypt the configuration data in encrypted form upon entry of the challenge code via an input component of the mobile computing device;

verify the configuration data using the challenge code entered by the user and the verification value received via the additional communication channel; and

configure the application program using the configuration data in response to verification of the configuration data.

17. The non-transitory computer readable storage medium of claim **16**, wherein the configuration data comprises at least a uniform resource locater (URL) of an additional server computer system, the non-transitory computer readable storage medium further having stored thereon computer executable code, which when executed by a computer causes the computer to perform actions subsequent to configuration of the application program including:

establishing an additional secure network connection between configured the application program on the mobile computing device and the additional server computer system using the URL contained in the configuration data;

authenticating the user of the mobile computing device against the additional server computer system; and

processing requests exchanged over the authenticated secure network connection between the configured application program on the mobile computing device and the additional server computer system.

18. The non-transitory computer readable storage medium of claim **16** further having stored thereon computer executable code, which when executed by a computer causes the computer to perform actions in response to the configuration request and subsequent to a successful authentication of the user over a secure network connection, the actions including:

retrieving the configuration data and the verification value; and

sending a response to the configuration request via the same additional secure network connection to a browser program of the mobile computing device, the response comprising the configuration data, the verification value, and a redirect to a custom URL scheme that references the configuration program module,

whereby the browser program executes the redirect to invoke the configuration program module.

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